Bryan W. Brooks[1], James P. Grover[2], Daniel L. Roelke[3]

[1]Baylor University, [2]University of Texas Arlington, [3]Texas A&M University

bryan_brooks@baylor.edu; grover@uta.edu; droelke@tamu.edu

ET&C FOCUS

In honor of ET&C's anniversary, we are pleased to introduce the second in a regular series of succinct and timely articles to sharpen our understanding of current and emerging topics of interest to the scientific community at large.

Prymnesium parvum: An Emerging Threat to Inland Waters

Bryan W. Brooks,* James P. Grover, and Daniel L. Roelke

Exxon Valdez. Cuyahoga River. Sandoz and the Rhine River. The names trigger memories of human activities that devastated aquatic ecosystems. The magnitude of such disasters prompted many countries to develop regulatory frameworks to manage risks of chemical contaminants to the environment and human health. For example, pesticides are thoroughly tested for adverse ecological effects. When unacceptable risks are identified, a variety of management efforts may be employed to minimize damage, including adjusting the amount or timing of pesticide application to riparian habitat to reduce the pesticide's contact with adjacent aquatic systems. In contrast to chemical contaminants, however, standard management approaches are poorly developed for the aquatic toxins produced by algae during harmful algal blooms (HABs), such as the infamous ''red tide.'' Algal blooms result from a period of rapid growth of algae in response to a variety of environmental factors, and HABs produce toxins that negatively impact other organisms, including other aquatic life and even humans. The global increase in frequency and magnitude of HABs over the past few decades has resulted in damaging effects that range from massive fish kills to public health threats such as ciguatera poisoning. Although the majority of HAB research has occurred in marine systems, on species such as *Pfiesteria* sp., *Gambierdiscus toxicus*, and *Karenia brevis*, HABs are increasing in inland waters. Unfortunately, the environmental conditions that cause HABs are complex and often species-specific, making it difficult—if not impossible—to develop a universal approach for managing HABs.

Prymnesium parvum: Invasive Golden Alga

Since 2000, increasing HABs of *Prymnesium parvum*, an invasive golden alga, have produced devastating fish kills in inland waters of the United States [1] and compromised municipal water supplies. *Prymnesium parvum* blooms can span more than 80 km^2 across entire lakes and can even propagate hundreds of kilometers downriver. By a conservative estimate, *P. parvum* has caused the loss of tens of millions in U.S. dollars in natural resource damages and has killed 34 million fish in the state of Texas alone [2]. In fact, managers no longer stock sport fish in some lakes due to repeated, fish-killing *P. parvum* blooms (Box 1). Furthermore, seasonal *P. parvum* blooms in reservoirs adversely affect municipal water supplies. Media coverage of environmental damage resulting from *P. parvum* blooms has yet to gain the high-profile status typically reserved for other damaging incidents such as oil spills. However, the rise of recurrent HABs may constitute a much larger problem than we realize, particularly in light of climate changes that could exacerbate their damaging effects. Adapting the existing risk assessment and management paradigms for protecting aquatic life, which focus on chemical contaminants, into a management strategy for *P. parvum* is confounded by the fact

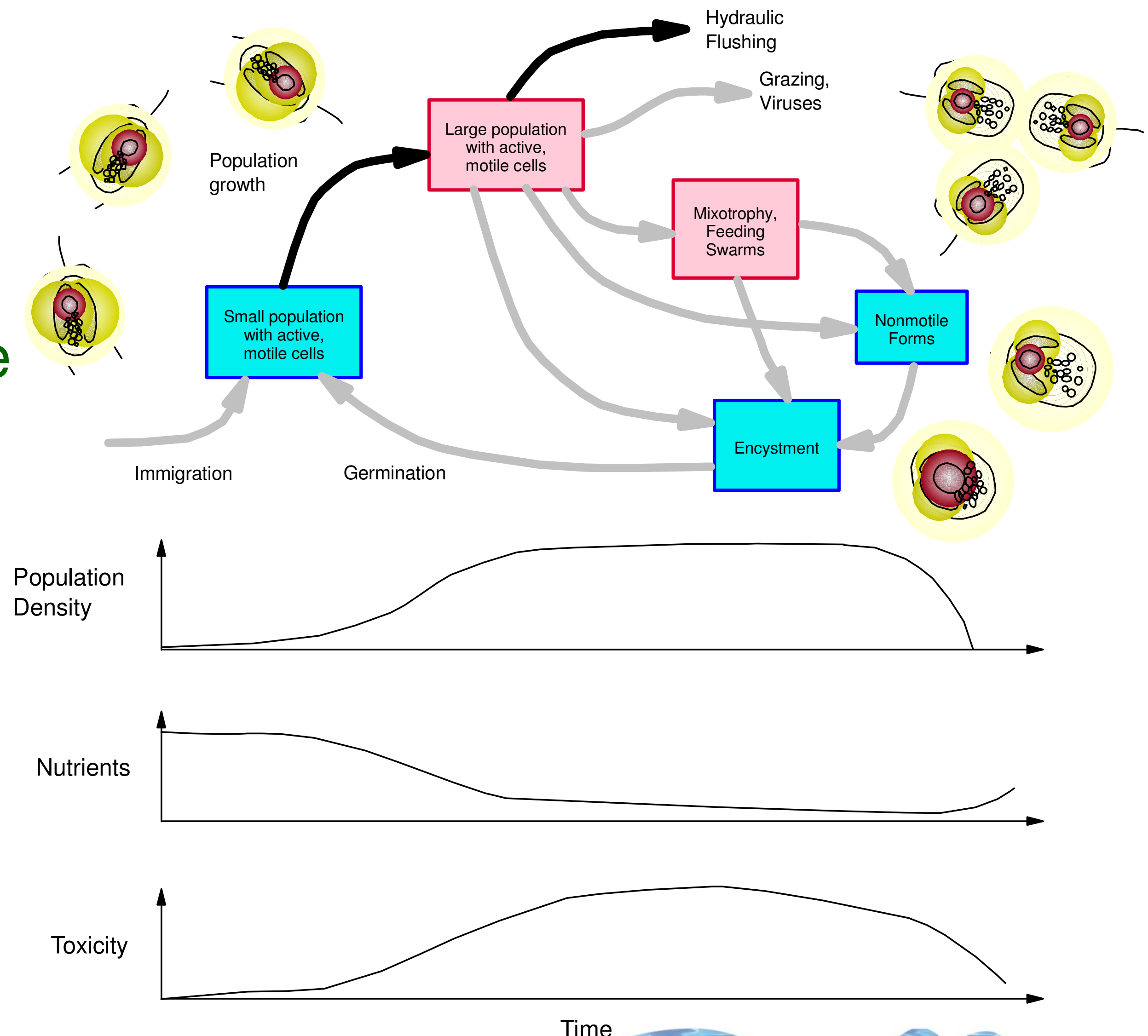
* To whom correspondence may be addressed: (Bryan_Brooks@baylor.edu).

Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/etc.613

Center for Reservoir & Aquatic Systems Research

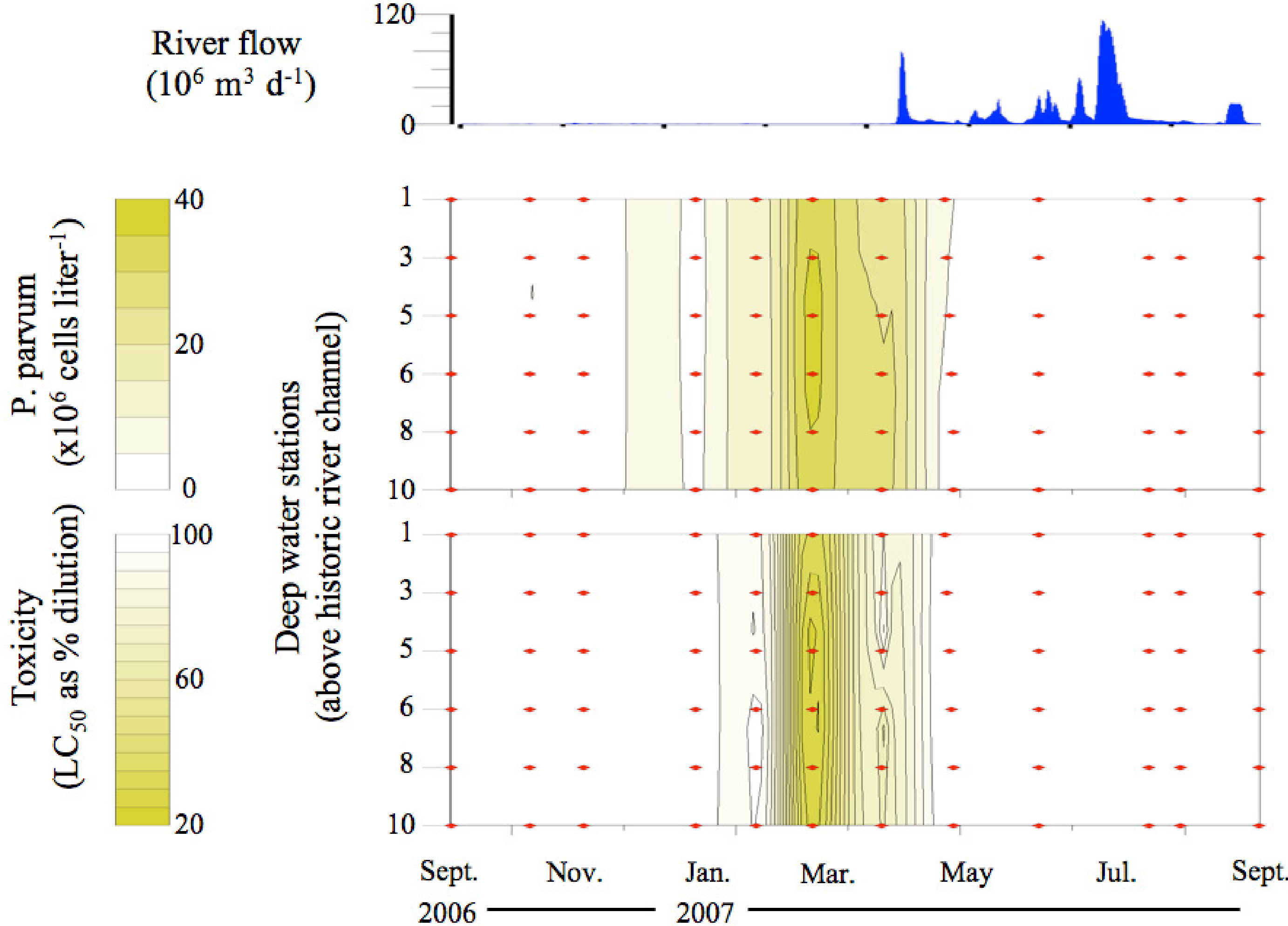
After 9 years of research, we now have an advanced and even a predictive understanding of the factors causing harmful blooms of *Prymnesium parvum* in the Brazos River.

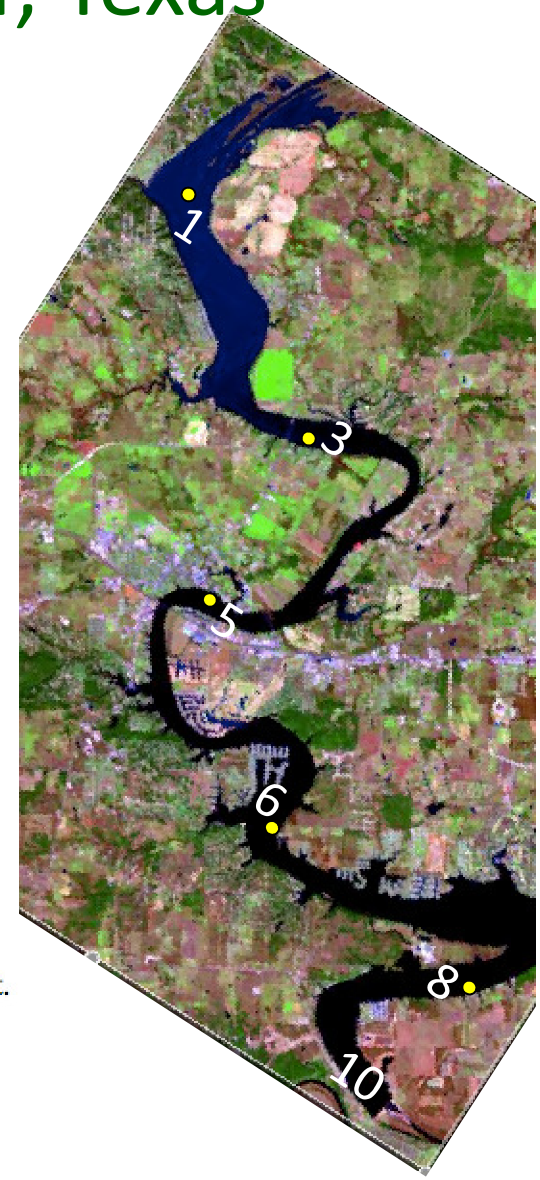
Salinity, hydrology are critical factors.



Brooks, Grover, Roelke. 2011. *Environmental Toxicology and Chemistry*

Hydraulic flushing terminates a toxic bloom in Lake Granbury, Brazos River, Texas





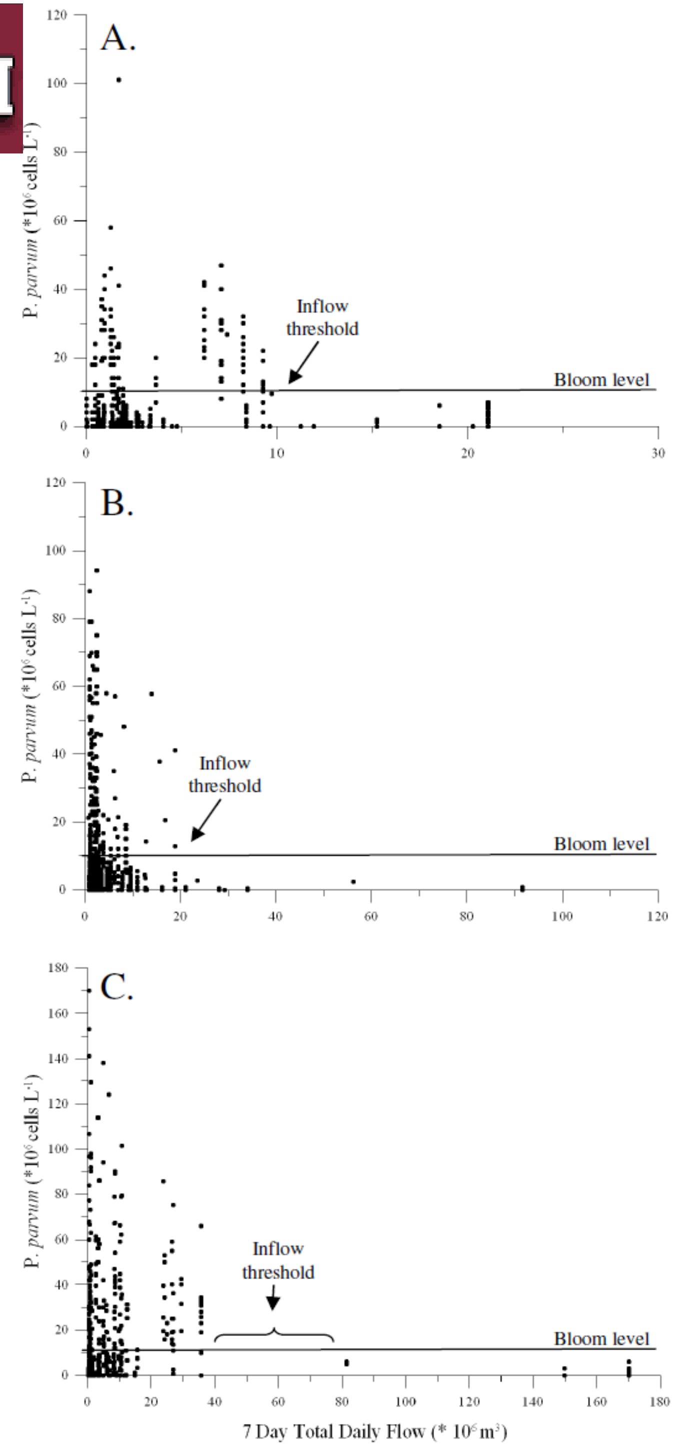
- Bloom initiation prior to Feb. 2007
- Development, peak and decline Feb. through April
- Abrupt termination between April and May

Roelke et al. 2010. *Harmful Algae*

BAYLOR UNIVERSITY

The University of Texas ARLINGTON

Brazos Reservoir Blooms



Hydrology Thresholds Identified

- ~10 $\times 10^6$ m^3 d^{-1} Possum Kingdom (2,742 MGD)
- ~20 $\times 10^6$ m^3 d^{-1} Granbury (5,283 MGD)
- ~40 $\times 10^6$ m^3 d^{-1} Whitney (10,567 MGD)

(Roelke et al. 2011. *Journal of Plankton Research*)

Bloom Termination

- High inflows not a requirement; modest inflows can terminate a bloom (Roelke et al. 2011. *JPR*)
- Modest flows can also help to prevent blooms from forming in the first place (not just terminate them) (Grover et al. 2012. *Ecological Modelling*)